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ABSTRACT

The main focus of current discussions within the standardization process of learning technology is on economical opportunities and technical aspects of learning objects. There has been little discussion about the instructional or didactical issues. The purpose of this paper is to conceptualize a taxonomy of learning objects for the facilitation of reusable instructional navigation patterns. Discussion includes the vision--a marketplace of knowledge and education; the current situation with the Web and the role of metadata; standardization initiatives; a hierarchy of learning objects; different types of knowledge units and the types of knowledge in the receptive knowledge units (orientation, explanation, action, and source knowledge); and generic navigational structures based upon the hierarchy concept and didactical typification to support learning processes. (AEF)

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Learning Objects – Instructional Metadata and Sequencing

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Abstract: The main focus of current discussions within the standardization process of Learning Technology is on economical opportunities and technical aspects of so called learning objects. Surprisingly little discussion is about the instructional or didactical issues. The purpose of this paper is to conceptualize a Taxonomy of learning objects for the facilitation of reusable instructional navigation patterns.

ED 479 599

Introduction

At the dawn of the 21st century the industrial society is being influenced by dramatic technological development which calls for continuous actualization and advancement of peoples' know-how and capabilities in order to keep companies and economies competitive. Slogans such as "Lifelong Learning" and "Learning on Demand" verify the tendency of changing forms of learning, media, and communication as well as the inherent transformation of an industrial society into an information society.
The classical résumé - school, apprenticeship, university, career, and retirement - has therefore been increasingly challenged. Whoever wishes to be successful on the job market must continue to educate themselves in a focused manner - further education has thus become more and more a basic human need.
This basic need is, however, still faced with many barriers: training is expensive and time consuming, it often only conveys overall views and relies upon a particular time and place. In addition, it cannot be optimally adapted to individual needs as the interests of all participants must be taken into account.

The Vision - a marketplace of knowledge and education

While considering the above, imagine it was possible to access a potentially endless amount of learning material - presentations, videos, learning programs by various suppliers - right from one's own working place, to participate in training courses and classes on the other side of world. A global market of further education without any access limitations whatsoever, available to anyone anywhere, combined with the opportunity of contacting other pupils or tutors. A marketplace in which public and private institutions both compete with and complement one another, the result being effective and personalized further education - moving away from predetermined career options to individual qualification profiles.

The current situation

Internet and the World Wide Web (WWW) respectively offer ideal conditions for such a vision: they are globally available, multimedia, accessible to everyone, and also open up new opportunities in communications and cooperation. They thus allow the combination of varied further education offers ranging from simple text documents to interactive virtual classroom training, making them available to any location on Earth.

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In this sense, the WWW is becoming the technological basis of knowledge globalization, a universal library accessible worldwide. At the same time, however, major problems arise in conjunction with a flexible usage of this worldwide knowledge for educational and further educational processes. Some examples include the consistency of courses already in existence, the retrieval of relevant and significant information regarding the respective thematic and didactical context as well as usage rights and payment.
Metadata, data which supplements existing information in the web with information on resources (based on additional or metainformation), illustrates one way of dealing with these problems.
Metadata is thus information *about* the resources themselves and should characterize the knowledge modules in such a way so that they can be found more easily in a given context.

Standardization Initiatives

Against this backdrop numerous standardization syndicates have been founded during the last few years. Their goal has been to define open technical standards for computer supported learning environments and education products and their characteristic metadata. The most important initiatives are the Aviation Industry CBT Committee (AICC)[1], the Instructional Management Systems Project (IMS)[2], the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE)[3], the World Wide Web Consortium (W3C)[4], and the Advanced Distributed Learning Initiative (ADL)[5].

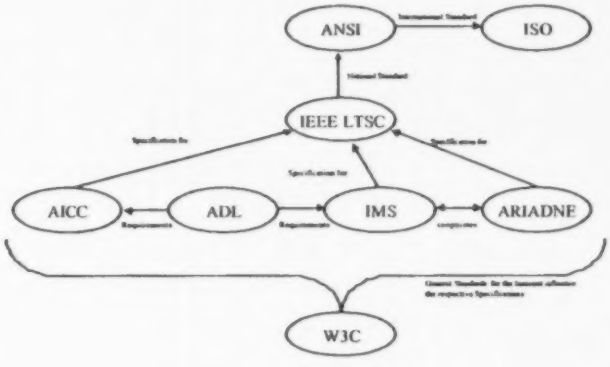

Figure 1: Network of the contributing partners to the standardization process

Following the initial independent running of these standardization endeavors, especially the IMS and ADL have now begun an attempt at harmonizing results and, within the framework of an IEEE Learning Technology Standards Committee (IEEE LTSC)[6] work group, are establishing an internationally recognized and

[1] http://www.aicc.org
[2] http://www.imsproject.org
[3] http://www.ariadne.unil.ch
[4] http://www.w3.org
[5] http://www.adlnet.org
[6] http://www.manta.ieee.org

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expandable standard.
Within these groups the main focus is on the financial opportunities that may arise, but surprisingly there is scarcely a discussion about the didactical or instructional design implications of learning objects (cf. Wiley 2002).
Consecutively I will try to conceptualize an approach for didactical sequencing of learning objects based on a specific set of educational metadata and thereupon synthesized generic sequencing strategies.
The goal is to develop a domain specific ontology for the educational science field capable of typifying teaching and learning material.

Learning Objects

In order to guarantee an optimal maintenance and reusability of contents, object oriented approaches are applied to the maintenance of multi-media teaching and learning material. Reusability, adaptation, and composition mechanisms are therefore employed to structure knowledge contents and so-called **learning objects** (LO) are defined. A learning object reduces the knowledge of a specific theme to its most essential unit. LOs may be divided into even smaller LOs. At its most basic level, a learning object is made up of several knowledge units (KUs) which may consist of texts, audio and video presentations, or animation. At this point the problem of granularity of learning objects arises. Following Wiley (2002, p. 10) "the decision regarding learning object granularity can be viewed as a trade-off between the possible benefits of reuse and the expense of cataloging. From an instructional point of view, alternatively, the decision between how much or how little to include in a learning object can be viewed as a problem of scope. While reality dictates that financial and other factors must be considered, if learning is to have its greatest chance of occurring, decisions regarding the scope of learning objects must also be made in an instructionally-grounded, principled manner."
A heuristic approach helps to balance between economical and instructionally-grounded criteria: The most basic learning object is understandable on its own and coherent, which means without references to other learning objects.
Combination of learning objects leads to the following hierarchy of learning objects:

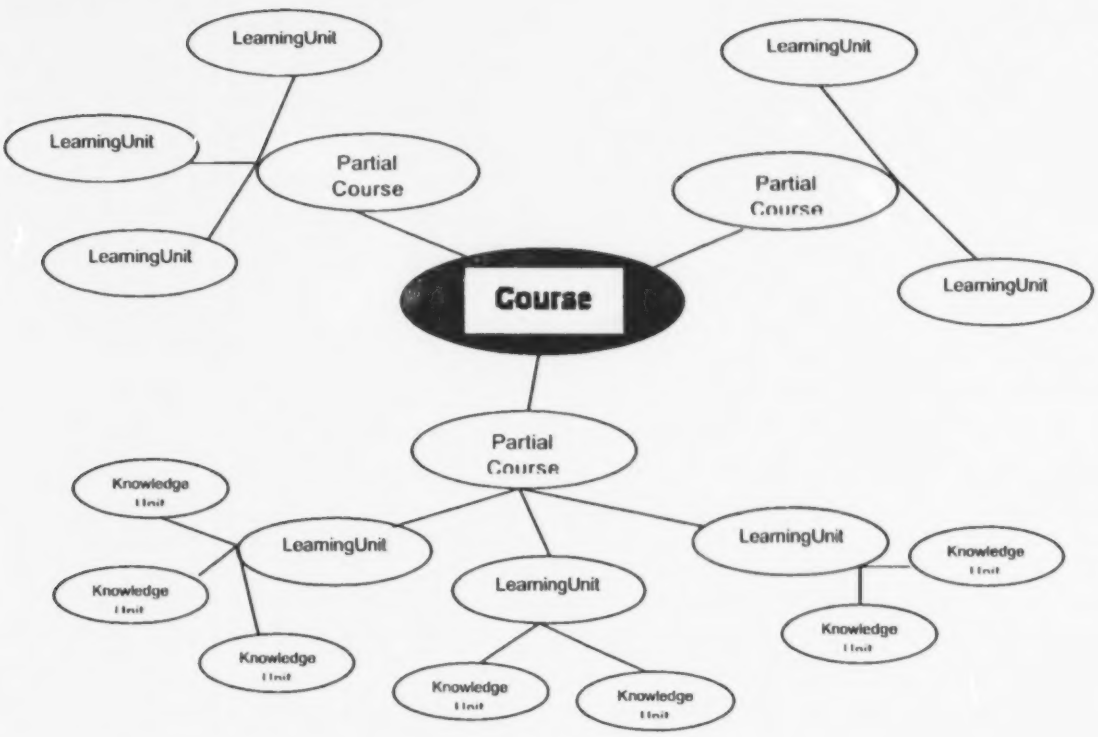

Figure 2: Hirarchy of learning objects

Hierarchy of learning objects

Course

Courses are defined as a sequence or network of learning units. Courses may - especially considering their reusability in other contexts - be divided into smaller, partial courses. A course encompasses about 30 to 60 hours of active learning time (ALT).

Partial course

Being containers, partial courses can comprise learning and knowledge units as opposed to learning units, which are solely made up of knowledge units. Partial courses are primarily designed as containers for learning units and should therefore not solely be made up of knowledge units. A partial course encompasses about 3 to 6 hours of active learning time (ALT).

Learning Unit

Learning units[7] are containers for thematically related knowledge units. Learning units are self-contained and can be, for example, reused in another course. The learning units' structure and order are defined as the macrostructure of the learning environment.

One learning object encompasses about 20-40 minutes of active learning time (ALT).

Learning units can be classified according to a three-tier thematic outline into fields (highest level), areas

[7] The definition in this context is based on essays by Merrill (no year given) who speaks of so-called knowledge objects in conjunction with his instructional-transaction-approach.

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(second level), and themes (lowest level).
Using learning units makes it possible to easily exchange contents or to integrate them by combing them with other learning objects to make a new system. In this way, a high degree of exchangeability, expandability, and adaptivity can be achieved on a whole. Isolated knowledge pertinent to a particular theme can thus be more easily reused. In addition, the translation of learning environments into different languages based upon the independent management of media elements such as texts and sounds is notably eased.
In order to be able to make flexible and meaningful (re)use of learning objects in different (learning) contexts, at least three different types of knowledge objects must be present: an "orientation knowledge" object, an "explanation knowledge" object, and an "action knowledge" object. Practically speaking, a learning unit is has to have a good deal more knowledge units in order to meaningfully and cohesively portray a thematic subject. Representing a knowledge unit in several different media is, for example, very useful.

Knowledge unit

Knowledge units are the smallest elements of knowledge. Knowledge units make up the components of a learning unit within which they can be flexibly combined. As opposed to a traditional learning system and a "tightly wired" hypertext, they can be combined in any arrangement desired. The respective structure and order of knowledge units within a learning unit is defined as the learning environment's microstructure. When defining the size of a knowledge unit it is assumed that it is no larger than one monitor sheet, or, in regard to videos or mini-CBTs, it should not be any longer than 2-4 minutes of active learning time (ALT).
Within this framework, a knowledge unit is clearly defined according to the following dimensions:

	Receptive Knowledge Units	**Interactive Knowledge Units**	**Cooperative Knowledge Units**
Thematic Dimension	Three or more tier thesaurus		
Competence Dimension	Bloom's Taxonomy (possibly refined)		
Media Dimension	Ontological outline of presentational media	Ontological outline of interactive media	Ontological outline of communications media
Knowledge Dimension	Ontological outline of type of knowledge answers to questions	Ontological outline of types of tasks / filling out blanks	Ontological outline of forms of cooperation (Knowledge communication)
Relational Dimension	Thematic relation (didactics for guided tour)	Integration in learning object with didactic relations (didactics belongs in this context)	Thematic relations in regard to cooperation themes, otherwise didactic relations

Figure 3: Typing-Dimensions for Knowledge-Units

Three different types of knowledge units can be distinguished:

1. *Receptive* knowledge units
2. *Internally interactive* knowledge units the size of the smallest interactive learning sequences (up to 5 minutes) and
3. *Cooperative* knowledge units which have no time limits and are defined by communicative tasks.

The learner's role in the respective learning objects varies:

- *Receptive learning objects* place the learner in the role of merely consuming information, i.e. he or she is receptive. The learner's activity takes place outside of the module regarding the selection of a particular module, the order of the modules, as well as the time spent on the modules.
- *Internally interactive learning objects* integrate the learner in the human-computer-interaction. The learner is either CBT guided - albeit in a mini-CBT sequence - or is given the framework of his or her activities via simulation.
- *Cooperative learning objects* demand communicative activities of the learner such as brainstorming, debating, or problem solving with other learners in a group.

Cooperative learning objects are defined as "Points of Cooperation" (PoC). A PoC is thus a passage of the learning and navigation processes in which several learners can work together on a (learning) task or work on and solve a problem together.

It can be distinguished between:

- *iPoCs* (*i*ntentional *P*oint *o*f *C*ooperation) if the cooperation is intended by the learning material or trainer/tutor and is integrated in the course plan during the course of navigation and
- *sPoCs* (*s*pontaneous *P*oint *o*f *C*ooperation) which refer to occurrences during the course in which learners spontaneously and indiscriminately cooperate with one another.

Accordingly, sPoCs can occur at any time the learner wishes whereas iPoCs are predetermined by the course material and can only be activated at certain times.

Each knowledge unit is thus typed according to the following didactically relevant dimensions:

1. In the *thematic dimension*, meaning a didactical object is classified according to a given topic (semantic/subject didactic dimension). According to the thematic area, this typification is carried out using a controlled vocabulary in the form of a three or more tier thesaurus.

2. In the *competence dimension*, meaning an ability correlates to the didactical object (pragmatic dimension). Here we make brief use of a typification similar to Bloom's Taxonomy (cognitive, emotive, sensorimotor) supplemented by the social dimension. As the definition of competence regarding a mode of operation is problematic and a part of this information is a dependent upon the type of knowledge, it remains uncertain whether or not a typification in the competence dimension is necessary.

3. In the *dimension of media presentation forms*, meaning at least one medium exists in which the knowledge contents can be portrayed and acquired.

4. In the *knowledge dimension*, meaning as an answer to questions, as the type of tasks, or as didactically pre-structured dramaturgy of knowledge (forms of cooperation).

5. In a *relational dimension*, through which the course of acquiring knowledge can be determined.

In the following I will discuss and exemplify the didactical typification of receptive knowledge units in more detail according to the knowledge types "orientation knowledge", "explanation knowledge", "action knowledge", and "source knowledge".

Types of knowledge in the receptive knowledge units

Knowledge is understood as an answer to posed questions . The types of knowledge in the receptive knowledge units are classified according to the questions "What is there?" and/or "Is there anything at all?"

(*orientation knowledge*), "Why is something the way it is?" and "What is it if it does exist?" (*explanation knowledge*), "How can it be applied?" (*action knowledge*) and "Where is there more knowledge?" (*source knowledge*). The following is a brief description of the different types of knowledge:

2.3.1 Orientation knowledge

Orientation knowledge answers the question: "What is there?"

This deals with knowledge needed in order to understand one's world and/or a particular field without having to explain or act in a specific manner.

Orientation knowledge offers a primary sketch of a topic and its further context. It motivates further exploration and awakens interest. Scenarios, stories, and facts are especially appropriate for an orientation.

2.3.2 Explanation knowledge

This deals with knowledge which explains why something is the way it is or gives arguments which must be supported by statements and recommendations.

2.3.3 Action knowledge

Action knowledge is knowledge based upon actual human activities (practices, techniques, methods, and strategies), abilities, and skills (know-how).

2.3.4 Source knowledge

Source knowledge is knowledge about sources of information (know where). It answers the question: "Where is further knowledge?"

Outlook: Generic navigational Structures

Within this conceptual framework courses are defined as a sequence and/or network of learning units. Individual learning units are in turn made up of a sequence and/ or network of knowledge units. This hierarchy results in more complex reusability and guarantees logical learning objects (i.e. learning units).

The goal of further development is to implement so-called *generic navigational structures* based upon the hierarchy concept and didactical typification in order to support writing and learning processes.

Generic navigational structures relate to the question of how teaching contents should be sequenced, in more concrete terms, which pre-structured navigation opportunities should be presented to the learner in the learning environment.

Transparency of relationships existing between knowledge units and between learning units respectively forgoes this kind of regulated navigation.

The number of modules for a certain topic form a learning unit. The learning process within a learning unit is called a micro-process. It is – as in conventional lessons – extremely adaptive, meaning dependend upon the situation (upon learning type, communication among other marginal conditions). For this reason all modules in a learning unit are reciprocally linked to one another, otherwise the adaptivity mentioned would not exist. Partial reduction of this link complexity can be considered: for example, a single link could exist to a part of the action knowledge modules whereas all action knowledge modules are linked to one another.

Depending upon the topics, the internally complex learning units are linked according to semantic networks and/or cognitive maps (knowledge maps). This structure is called a macro-didactical structure. The main questions are: Which relationship exists between term A which, as a super-character, defines topic A' to term B, which, as a super-character, in turn defines topic B'? Which learning prerequisites lie within term C which, as a super-character, identifies topic C'? etc. These generic navigational structures are to be understood as analogue to a guided tour, as recommendations, not as strict regulations. An author giving a guided tour suggests the navigation sequence but does not make it mandatory (although this should also be possible). In the same way, the system suggests navigation structures according to certain marginal conditions. Such navigation *recommendations* could be: exemplary teaching/learning in the micro-field with a top-down-structure in the

macro-field, spiral in the macro-field, and action oriented in the micro-field, to name a but a few. Such system structures are to be seen as a didactical advice the learner can follow but does not necessarily have to.

References

Kerres, Michael: Multimediale und telemediale Lernumgebungen. Konzeption und Entwicklung. München 1998.

L^3: Lifelong Learning. Homepage of the BMB+F Lead-Project: URL: http://www.l-3.de

Merrill, M. David (no year given): Instructional Transaction Theory. Instructional Design based on Knowledge Objects. URL: http://itech1.coe.uga.edu/itforum/paper22/paper22a.html

SAP Learning Solution (2002): https://www005.sap-ag.de/learningsolution

Schaper, Joachim: Lebenszyklusunterstützung in kooperativen Lehrsystemen. Shaker-Verlag, Aachen 1996.

Wiley, David A. (2002): Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy. In: David A. Wiley (Ed.): The Instructional Use of Learning Objects. Agency for Instructional Technology and Association for Educational Communications & Technology, Bloomington, Indiana, pp. 3-23.

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